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Two New Species of *Munnogonium* (Isopoda: Asellota: Paramunnidae) from Japan

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Two new species of *Munnogonium* are described from Japan as the first record of this genus from the Western Pacific. *Munnogonium armigerum* sp. nov. is distinguished from the most similar species, *M. adensis* Müller, 1991, by its anterior four pereonites armed with some acute teeth laterally, though the two species share the uniramous uropod and the distomesially projected article 3 of antenna 2. *Munnogonium orientale* sp. nov. shows similar sexual dimorphism to that of *M. maltinii* (Schiecke and Fresi, 1972): the article 3 of antenna 2 is twice as broad in males as in females. The present new species differs from all its congeners in having a short anterodorsal projection of the head, pleopod 1 with a pair of long, broad, lateral projections, and male coxal plates 1–4 with one spine each.

Key Words: *Munnogonium*, new species, Paramunnidae, Asellota, Isopoda, Western Pacific, Japan.

Introduction

Munnogonium is a small genus in the family Paramunnidae. It includes 10 species, all from marine benthic habitats (Hooker 1985; Müller 1989, 1991; Kensley 1994). Although literature records (Hodgson 1910; Menzies and Barnard 1959; Menzies 1962; Schultz 1964; Schiecke and Fresi 1972; Kensley 1976, 1994; Hooker 1985; Müller 1989, 1991) suggest that the members of the genus are distributed widely in the world's oceans, no *Munnogonium* species has been recorded from the Western Pacific, where the marine fauna is highly diverse. Our coastal survey in Japan yielded two new species of *Munnogonium* as the first record of this genus from the Western Pacific.

Materials and Methods

Sediment samples obtained in the field by using a Smith-McIntyre grab or a sledge-net were washed in a plastic bucket, and the suspension was decanted through a sieve or a plankton net with a pore size of 0.1 mm. The specimens retained were fixed with 5% neutralized formalin solution diluted with seawater and preserved in 70% ethanol. Each individual was dissected and prepared for observation using a light microscope equipped with Nomarski differential interference contrast (Shimomura and Mawatari 1999). Total length as indicated in "Material Examined" was measured from the tip of the head to the end of the pleotelson.

The type series is deposited in the Zoological Museum, Division of Biological Sciences, Graduate School of Science, Hokkaido University (ZIHU).

Descriptions

Munnogonium armigerum sp. nov.

(Figs 1–3)

Material Examined. TR/V "Toyoshio-maru", St. 10, Umoti-no-Se, off Yamaguchi Prefecture, Sea of Japan, 34°45.70′N, 130°45.13′E, 115 m, sand and mud, sledge net (mesh size 0.33 mm), 18 Nov. 1999: holotype, male, 1.3 mm (ZIHU-01315); paratypes, 2 males, 1.1 mm (ZIHU-01316), 1.0 mm (ZIHU-01317); paratypes, 1 ovig. female (1.4 mm), 4 juv. (0.5 mm) (ZIHU-01318).

Description. *Male*: Body (Fig. 1A) about twice as long as maximum width. Head narrower than pereonite 1, with 6 dorsal setae; frontal margin of head convex, without setae; labrum surpassing head anteriorly; posterior margin of head convex. Eyestalks slender, arising from posterior half of head, reaching proximal 1/4 of peduncular article 1 of antenna 1. Pereonite 1 with 1 pair of dorsal setae; pereonites 2–7 each with 2 pairs of dorsal setae and 1 pair of anterolateral setae. Pereonite 1 with 3 pairs of lateral acute teeth; pereonites 3–5 each with 1 or 2 pairs of posterolateral acute teeth; pereonites 5–7 without acute teeth. Pereonites 1 to 3 increasing in width; pereonites 3 and 4 subequal in width; pereonites 5 to 7 decreasing in width. Pereonites 1 to 4 increasing in length; pereonites 5–7 subequal in length. Coxal plates dorsally visible on all pereonites; coxal plate of pereonite 1 unarmed or armed with 1 spine; coxal plates of pereonites 2–4 each with 1 or 2 spines and 1 seta; coxal plates of pereonites 5 and 6 unarmed, or both armed with 1 short spine and 1 seta; coxal plate of pereonite 7 with 2 spines and 1 seta. Pleonite ovate, without setae. Pleotelson longer than wide, with 6 dorsal setae and 14 posterior setae, laterally with 12–16 pairs of acute teeth, each tooth with blunt shoulder.

Antenna 1 (Fig. 1C) with 4-articulate peduncle and 2-articulate flagellum. Peduncular article 1 longest, distomesially bearing 1 simple and 1 filoplume-like setae; article 2 slightly shorter and narrower than article 1, distomesially bearing 2 setae and 4 filoplume-like setae; article 3 about 1/3 as long as article 2, with 1 distal seta; article 4 slightly shorter than article 3, with 1 distal seta. Flagellum article 1 longer than article 2; article 2 distomesially bearing 2 short setae, and apically 1 long seta and 1 aesthetasc.

Antenna 2 (Fig. 1D) with peduncle composed of 6 articles: article 1 not visible dorsally; article 2 shortest, without setae; article 3 longest, with convex proximolateral protrusion bearing 1 seta and convex distomesial protrusion bearing 2 setae; article 4 trapezoidal, with 2 distal setae; article 5 with 1 ventral, 1 distolateral, and 1 distomesial setae; article 6 shorter than article 4, with 11 setae. Flagellum as long as peduncular article 3, composed of 6 or 7 articles, each with 0–4 distal setae.

Right mandible (Fig. 1E) lacking lacinia mobilis; incisor with 5 cusps; spine row with 4 spines; molar process without setae. Left mandible's (Fig. 1F) incisor with 4 cusps; lacinia mobilis with 2 teeth; molar process with 2 short teeth.

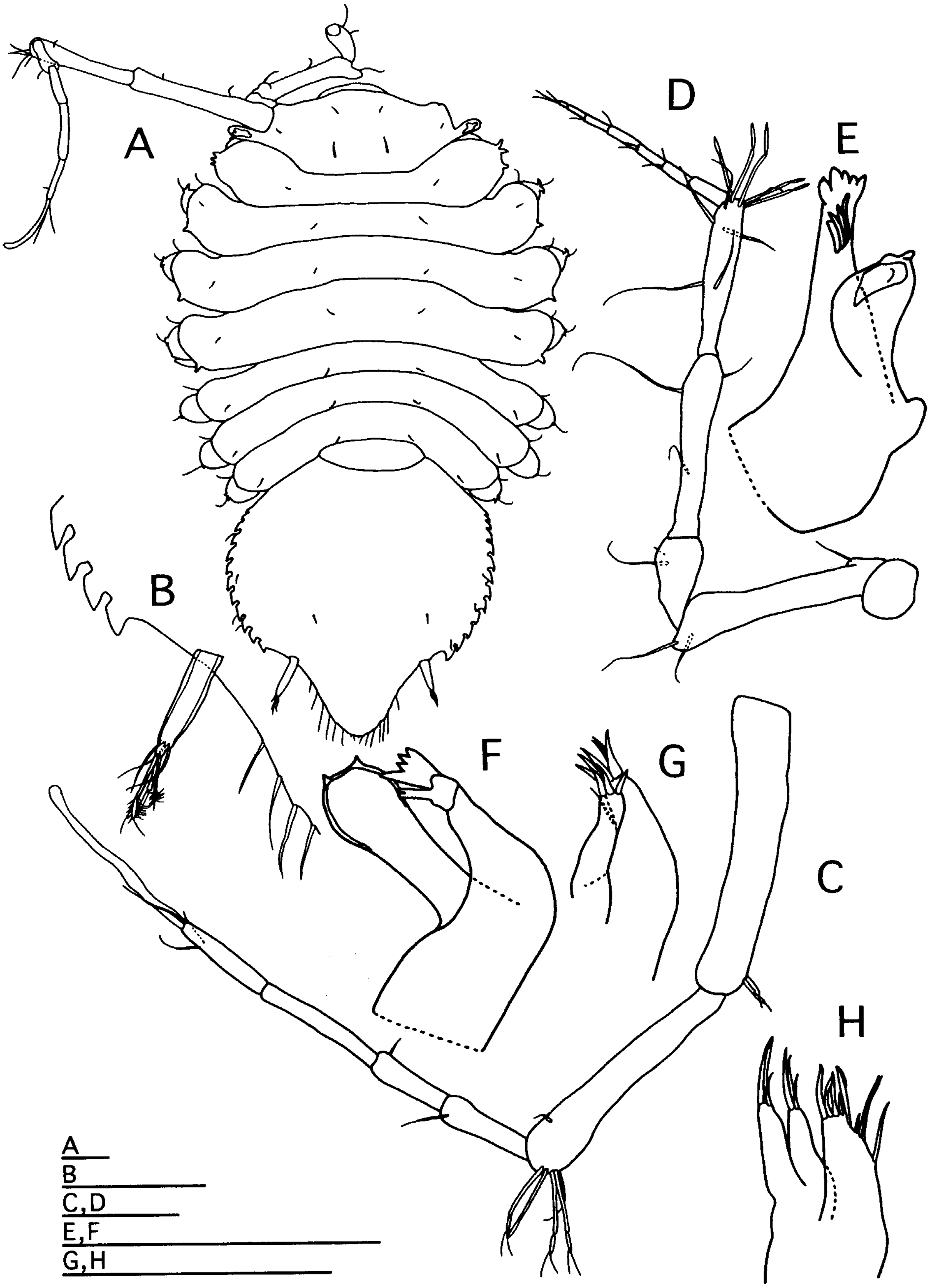

Fig. 1. *Munnogonium armigerum* sp. nov. A–C, G–H, holotype male; D–F, paratype male (ZIHU-01316): A, habitus, dorsal; B, left uropod, dorsal; C, right antenna 1, dorsal; D, right antenna 2, dorsal, first article not shown; E, right mandible, mesial; F, left mandible, ventral; G, right maxilla 1, dorsal; H, right maxilla 2, ventral. Scales=0.1 mm.

Maxilla 1 (Fig. 1G) with inner lobe bearing 4 apical setae; outer lobe with 6 apical and 1 distomesial setae. Maxilla 2 (Fig. 1H) with inner lobe with 6 apical and 4 distomesial setae; outer 2 lobes each with 3 apical setae.

Maxilliped (Fig. 2A) with broad palp composed of 5 articles; article 1 shortest, with 1 mesial seta; article 2 trapezoidal, with 1 mesial seta; article 3 longest, with 3 mesial and 1 lateral setae; article 4 slightly shorter than article 3, with 2 mesial setae; article 5 narrowest, with 2 apical, 1 mesial, and 1 lateral setae; endite quadrate, bearing 10 setae distally and 2 coupling hooks mesially; epipod subtriangular, narrower than endite, reaching second article of palp, with rounded apex.

Pereopod 1 (Fig. 2B) shorter than pereopods 2–7: basis the longest article, with 2 ventral and 1 dorsal setae and 1 acute dorsal spine; ischium shorter than basis, with 1 ventral and 2 dorsal setae; merus trapezoidal, with 2 dorsal and 2 ventral setae; carpus longer than merus, with 3 curved, robust sensory setae and 1 straight robust sensory seta, 2 simple setae and 2 small teeth ventrally, and 1 dorsodistal seta; propodus longer than carpus, with 2 dorsal and 2 mesial setae, and with 3 simple setae and fringe of scales on ventral margin; dactylus shorter than propodus, narrowest of all articles, with 4 subdistal setae, 1 curved unguis, and 2 strong, acute accessory spines.

Pereopods 2–7 (Fig. 2C, D) increasing in length posteriorly; bases each with 1 dorsal and 2 ventral setae; ischia as long as bases, each with 1 or 2 dorsal, 2 ventral, and 1 distal setae; meri half as long as ischia, each with 1 or 2 dorsal, 3 ventral, and 0 or 1 distal setae; carpi as long as ischia, each with 2–4 dorsal and 1 or 2 ventral setae and 3 robust, ventral sensory setae; propodi shorter than carpi, each with 1 dorsodistal filoplume-like and 1 simple setae, with 0 or 1 simple dorsal setae, and with 2 robust sensory setae and 1 or 2 simple setae on ventral margin; dactyli each with 3 or 4 subdistal setae, 1 curved unguis, and 1 minute accessory spine.

Pleopod 1 (Fig. 3A) twice as long as wide, with 1 pair of short lateral projections, each projection bearing 2 setae arising from its base and 3 apical setae. Pleopod 2 (Fig. 3B) with broad protopod, lateral margin convex, with row of setae; endopod reaching apex of protopod, with slender second article; exopod stout. Pleopod 3 (Fig. 3C) with endopod bearing 3 stout, plumose setae distally; exopod composed of 2 articles, narrower than endopod; article 2 with 1 terminal seta. Pleopod 4 (Fig. 3D) with exopod slender, tapering to pointed apex; endopod broad. Pleopod 5 (Fig. 4E) narrow, uniramous, 2.5 times as long as broad.

Uropod (Fig. 1B) uniramous, cylindrical, with 5 simple and 3 filoplume-like setae distally.

Female: Similar to male in morphology of all pereonal appendages. Body about 1.9 times as long as maximum width, widest at pereonite 3. Pereonites 1 and 2 subequal in length; pereonite 3 longer than pereonite 2; pereonite 4 longest; pereonites 5–7 subequal in length. Operculum (Fig. 3F) ovate, 1.4 times as long as broad, with 22–25 pairs of setae laterally.

Remarks. *Munnogonium adensis* Müller, 1991 resembles the present new species in the shape of article 3 of antenna 2 and the absence of the endopod of the uropod. The original description of *M. adensis* was based on a single specimen from the Gulf of Aden, western Indian Ocean. Müller (1991) illustrated a pair of uniramous uropods on the pleotelson and stated, “Uropodal endopods broken off . . .” The members of this genus generally have normal, biramous uropods on the pleotelson. Although the appendages of asellote isopods are generally fragile and may

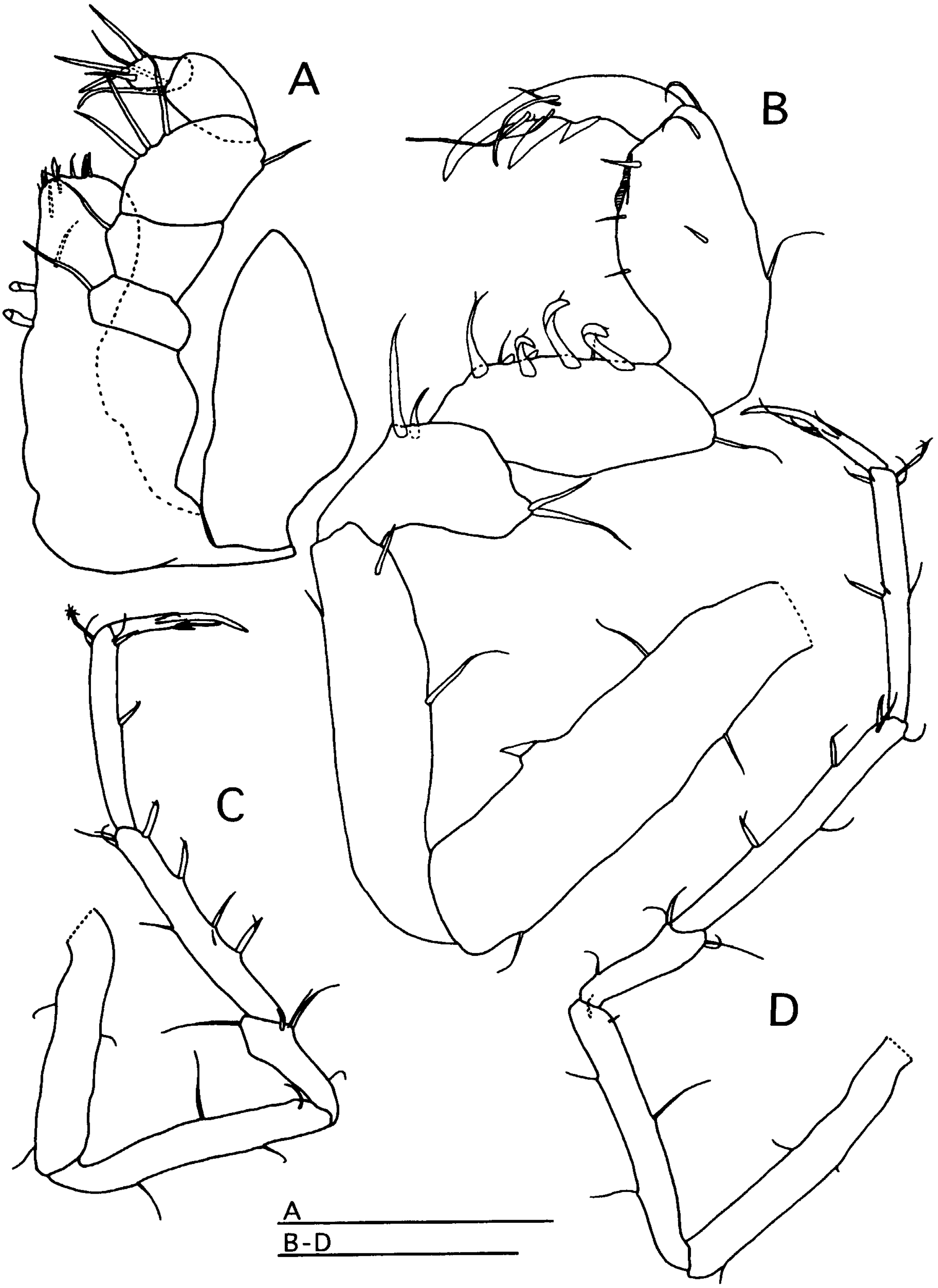

Fig. 2. *Munnogonium armigerum* sp. nov. A–D, holotype male: A, left maxilliped, ventral; B, right pereopod 1, mesial; C, right pereopod 2, lateral; D, right pereopod 7, mesial. Scales=0.1 mm.

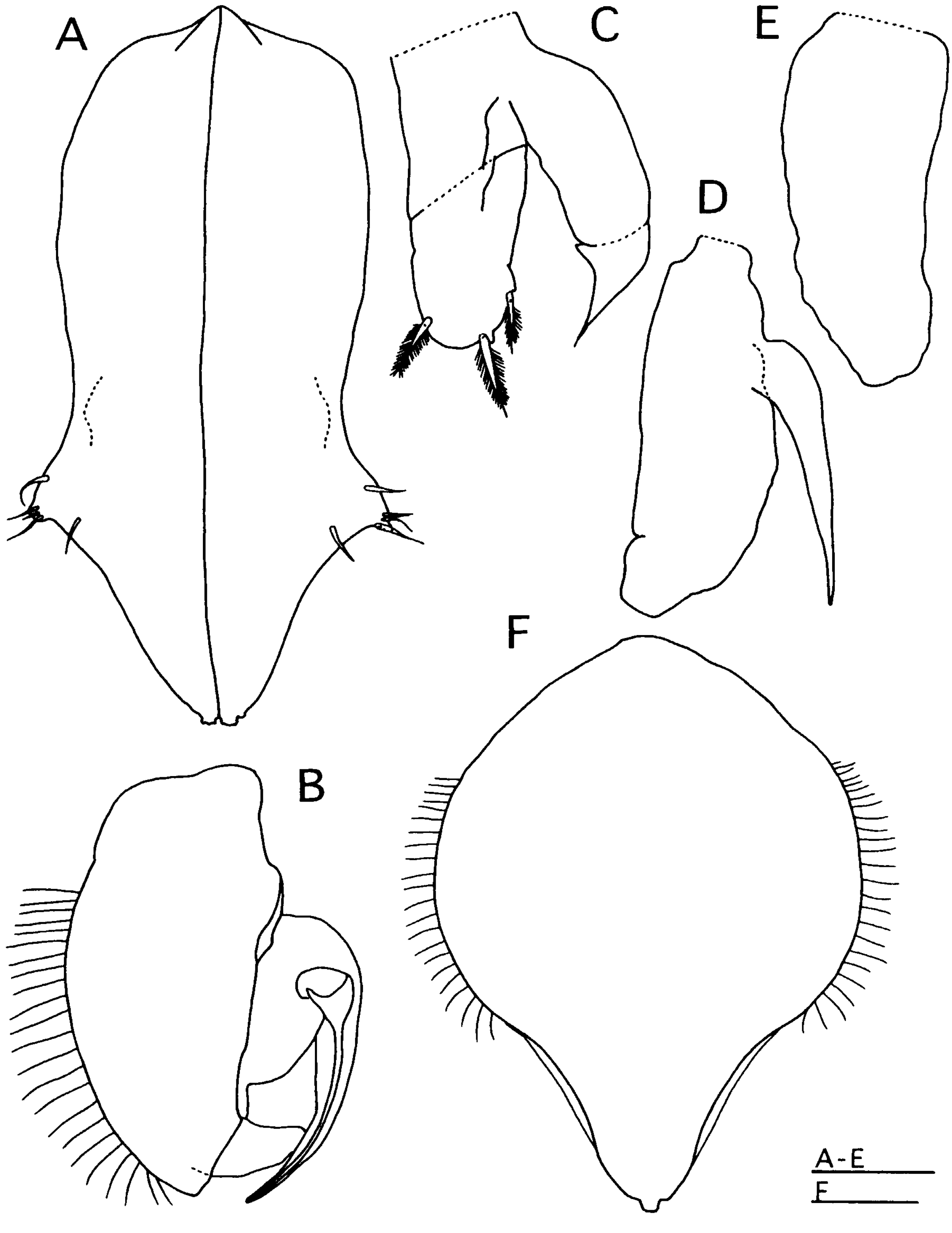

Fig. 3. *Munnogonium armigerum* sp. nov. A–E, holotype male; F, paratype female (ZIHU-01318): A, pleopod 1, ventral; B, right pleopod 2, ventral; C, left pleopod 3, ventral; D, right pleopod 4, dorsal; E, right pleopod 5, ventral; F, operculum, ventral. Scales=0.1 mm.

be easily broken during the process of collecting, it seems unlikely that both the right and left uropodal endopods of the holotype of *M. adensis* could have broken off simultaneously. Müller's observation may have been incorrect and the uropod of *Munnogonium adensis* may have been originally uniramous.

The present species is distinguished from *Munnogonium adensis* by the following features (those of *M. adensis* are given in parentheses): pereonite 1 with 3 lateral acute teeth, pereonites 2–4 with one or two posterolateral acute teeth (all pereonites lacking such acute teeth), coxal plates of pereonites 2–4 and 7 with 1 or 2 spines (lacking spines), and the pleotelson laterally bearing 12–16 pairs of teeth, each tooth with an acute tip and blunt shoulder (10 or 11 teeth, each with an acute tip but no blunt shoulder).

Munnogonium orientale sp. nov.
(Figs 4–6)

Material Examined. Off Shiso-Jima Island, Shirahama, Wakayama Prefecture, Japan, 10 m, sand and mud, Smith-McIntyre grab, 17 Nov. 1997: holotype, male, 0.9 mm (ZIHU-01319); paratypes, 2 males, 1.0 mm (ZIHU-01320), 0.7 mm (ZIHU-01321); paratypes, 2 ovig. females, 1.2 mm (with 9 eggs) (ZIHU-01322), 1.1 mm (with 8 eggs) (ZIHU-01323).

Description. *Male*: Body (Fig. 4A) about 1.8 times as long as maximum width. Head narrower than pereonite 1, with 6 dorsal setae and anterodorsal short projection with shallow notch; frontal margin convex, without setae; labrum surpassing head anteriorly; posterior margin of head convex. Eyestalks stout, arising from posterior half of head, reaching proximal 1/3 of peduncular article 1 of antenna 1. Pereonites 1–7 each with 2 pairs of dorsal setae and 1 pair of lateral setae. All pereonites laterally rounded; pereonites 1–4 subequal in width; pereonites 5 to 7 decreasing in width posteriorly. Pereonites 1–3 subequal in length; pereonite 4 longest; pereonites 5–7 subequal in length and shorter than pereonites 1–3. Coxal plates dorsally visible on all pereonites; coxal plates of pereonites 1–4 each with 1 spine and 1 seta; coxal plates of pereonites 5 and 6 each with 1 seta; coxal plates of pereonite 7 each with 2 spines and 1 seta. Pleonite ovate, with 1 pair of setae. Pleotelson as long as wide, with 10–12 dorsal and 10 posterior setae and 6–10 pairs of acute lateral teeth, these increasing in size posteriorly.

Antenna 1 (Fig. 4C) with 4-articulate peduncle and 2-articulate flagellum. Peduncular article 1 longest, distolaterally bearing 1 simple and 2 filoplume-like setae; article 2 slightly shorter and narrower than article 1, with 2 simple setae and 4 filoplume-like setae distolaterally and 1 mesial seta; article 3 half as long as article 2, with 1 distolateral seta; article 4 half as long as article 3, with 0 or 1 distomesial setae. Flagellum article 1 longer than peduncular article 4, with 1 distomesial seta; article 2 longer than article 1, apically bearing 2 short setae, 2 long setae, and 1 aesthetasc.

Antenna 2 (Fig. 4D) with peduncle composed of 6 articles: article 1 not visible dorsally; article 2 shortest, without setae; article 3 longest, twice as broad as article 3 of female antenna 2, with 3 lateral and 1 distomesial setae; article 4 trapezoidal, with 2 mesial setae; article 5 with 2 lateral and 2 distomesial setae; article 6 slightly shorter than article 3, with 2 lateral, 2 mesial, and 8 distal setae. Flagellum composed of 7 articles, each with 0–5 distal setae, longer than peduncular article 3.

Right mandible (Fig. 5B) lacking lacinia mobilis; incisor with 5 cusps; spine row with 4 spines; molar process without setae. Left mandible's (Fig. 5C) incisor with 2 cusps; spine row with 4 spines; lacinia mobilis with 4 teeth; molar process

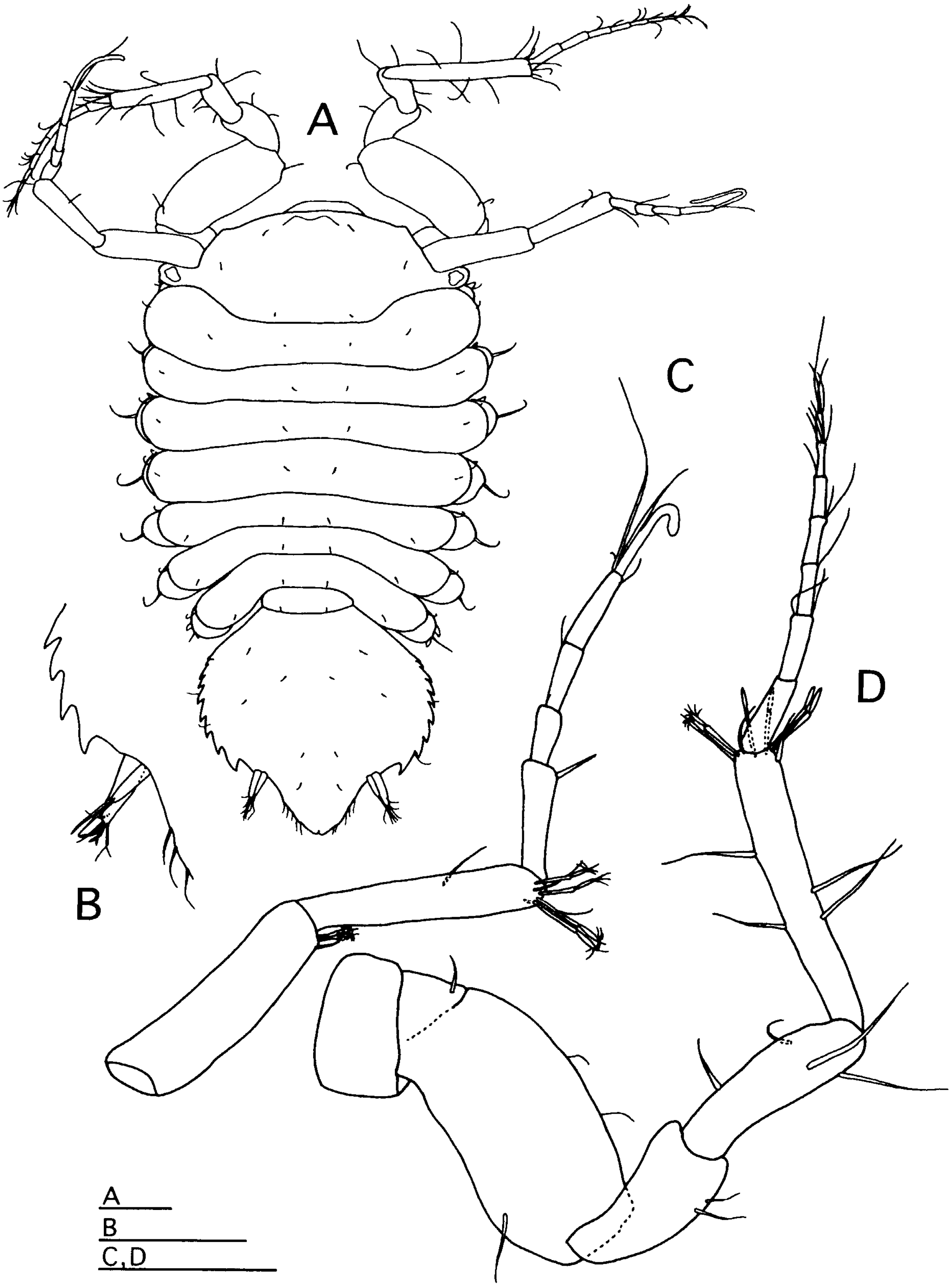

Fig. 4. *Munnogonium orientale* sp. nov. A–D, holotype male: A, habitus, dorsal; B, left uropod, dorsal; C, left antenna 1, ventral; D, right antenna 2, ventral, first article not shown. Scales=0.1 mm.

without setae.

Maxilla 1 (Fig. 5D) with inner lobe bearing 6 apical and 6 lateral setae; outer lobe with 8 apical setae. Maxilla 2 (Fig. 5E) with inner lobe bearing 9 apical and 3 distomesial setae; outer 2 lobes each with 3 apical setae.

Maxilliped (Fig. 5F) with palp composed of 5 articles; article 1 as long as terminal article, with 1 mesial seta; article 2 trapezoidal, with 1 mesial seta; article 3 longest, with 3 mesial and 1 lateral setae; article 4 slightly shorter than article 3, with 3 mesial setae; article 5 narrowest, with 4 apical setae; endite quadrate, bearing 6 distal setae, 2 fan-shaped ventral setae, and 2 coupling hooks mesially; epipod subtriangular, narrower than endite, reaching second article of palp, with rounded apex.

Pereopod 1 (Fig. 5G) shorter than pereopods 2–7: basis the longest article, with 1 ventral and 1 dorsal setae; ischium shorter than basis, with 1 dorsal seta; merus trapezoidal, with 1 dorsodistal and 1 ventrodistal setae; carpus longer than merus, with 1 dorsodistal seta, 2 ventral setae, 2 robust, ventral sensory setae, and 2 small teeth; propodus longer than carpus, with row of scales mesially and 3 ventral, 1 dorsal, and 3 dorsodistal setae; dactylus shorter than propodus, narrowest of all articles, with 4 subdistal setae, 1 curved unguis, and 1 acute accessory spine.

Pereopods 2–7 (Fig. 6A, B) increasing in length posteriorly; bases each with 1 or 2 dorsal and 0 or 1 ventral setae; ischia as long as bases, each with 0–2 dorsal and 2 ventral setae; meri half as long as ischia, each with 1 dorsodistal, 1 ventral, and 1 ventrodistal setae; carpi as long as ischia, each with 2 or 3 dorsal setae, 2 or 3 ventral setae, and 2 robust, ventral sensory setae; propodi shorter than carpi, each with 3 dorsal setae, 0 or 1 ventral setae, and 2 robust, ventral sensory setae; dactyli each with 2 or 3 subdistal setae, 1 curved unguis, and 1 minute accessory spine.

Pleopod 1 (Fig. 6C) 1.3 times as long as wide, with pair of long, broad, lateral projections, each projection bearing 1 long posterolateral seta and 3 short ventral setae. Pleopod 2 (Fig. 6D) with broad protopod, lateral margin convex, with row of setae; endopod surpassing protopod, with slender second article; exopod stout. Pleopod 3 (Fig. 6E) with endopod bearing 3 stout, plumose setae posteriorly; exopod composed of 2 articles, narrower than endopod; article 2 with 1 terminal seta. Pleopod 4 (Fig. 6F) with exopod slender, tapering to pointed apex; endopod broad. Pleopod 5 (Fig. 6G) narrow, uniramous, 3 times as long as broad.

Uropod (Fig. 4B) biramous; dorsal ramus slender, with 2 distal setae; ventral ramus with 7 distal setae.

Female: Similar to male in morphology of all pereonal appendages. Body about 1.8 times as long as maximum width, widest at pereonite 3. Pereonites 1–4 increasing in length; pereonites 5–7 subequal in length shorter than 1–4. Coxal plates of pereonites 1–4 not visible dorsally; coxal plates of pereonites 5–7 dorsally visible. Antenna 2 (Fig. 5A) with peduncle composed of 6 articles: article 1 not visible dorsally; article 2 shortest, without setae; article 3 slender, with 2 lateral and 2 distomesial setae and convex proximolateral protrusion bearing single seta; article 4 with 3 distal setae; article 5 with 3 distal and 1 short, lateral setae; article 6 longest, with 1 lateral, 1 mesial, 1 dorsal, and 6 distal setae. Flagellum composed of 7 articles, each with 0-5 distal setae, longer than peduncular article 2. Operculum (Fig. 6H) ovate, 1.4 times as long as broad, with 10–16 pairs of setae laterally.

Remarks. *Munnogonium maltinii* (Schiecke and Fresi, 1972) from the Mediterranean is known to show remarkable sexual dimorphism in the shape of the an-

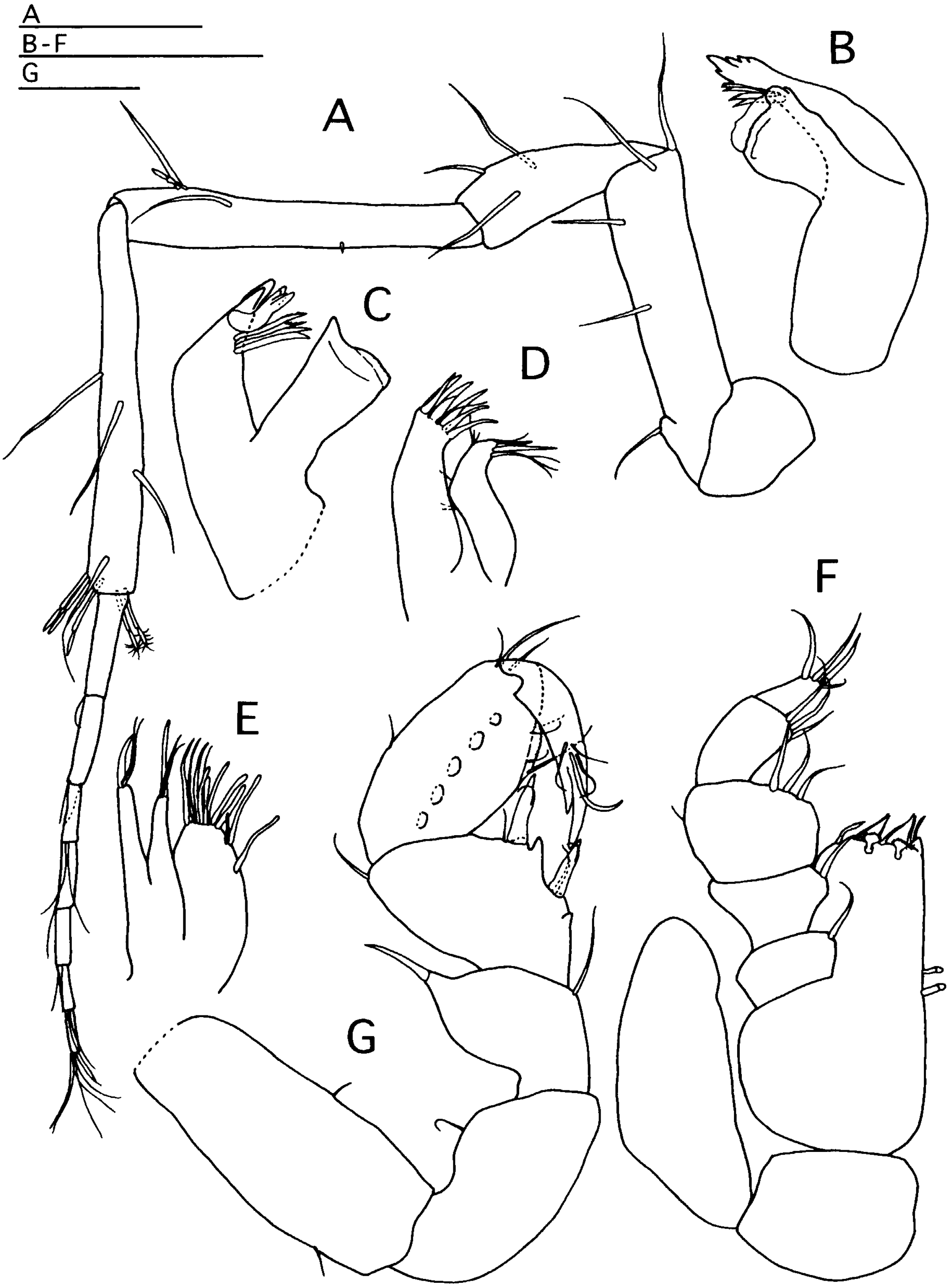

Fig. 5. *Munnogonium orientale* sp. nov. A–F, paratype female (ZIHU-01323); G, holotype male: A, right antenna 2, ventral, first article not shown; B, right mandible, dorsal; C, left mandible, dorsal; D, right maxilla 1, ventral; E, right maxilla 2, ventral; F, right maxilliped, ventral; G, left pereopod 1, mesial. Scales=0.1 mm.

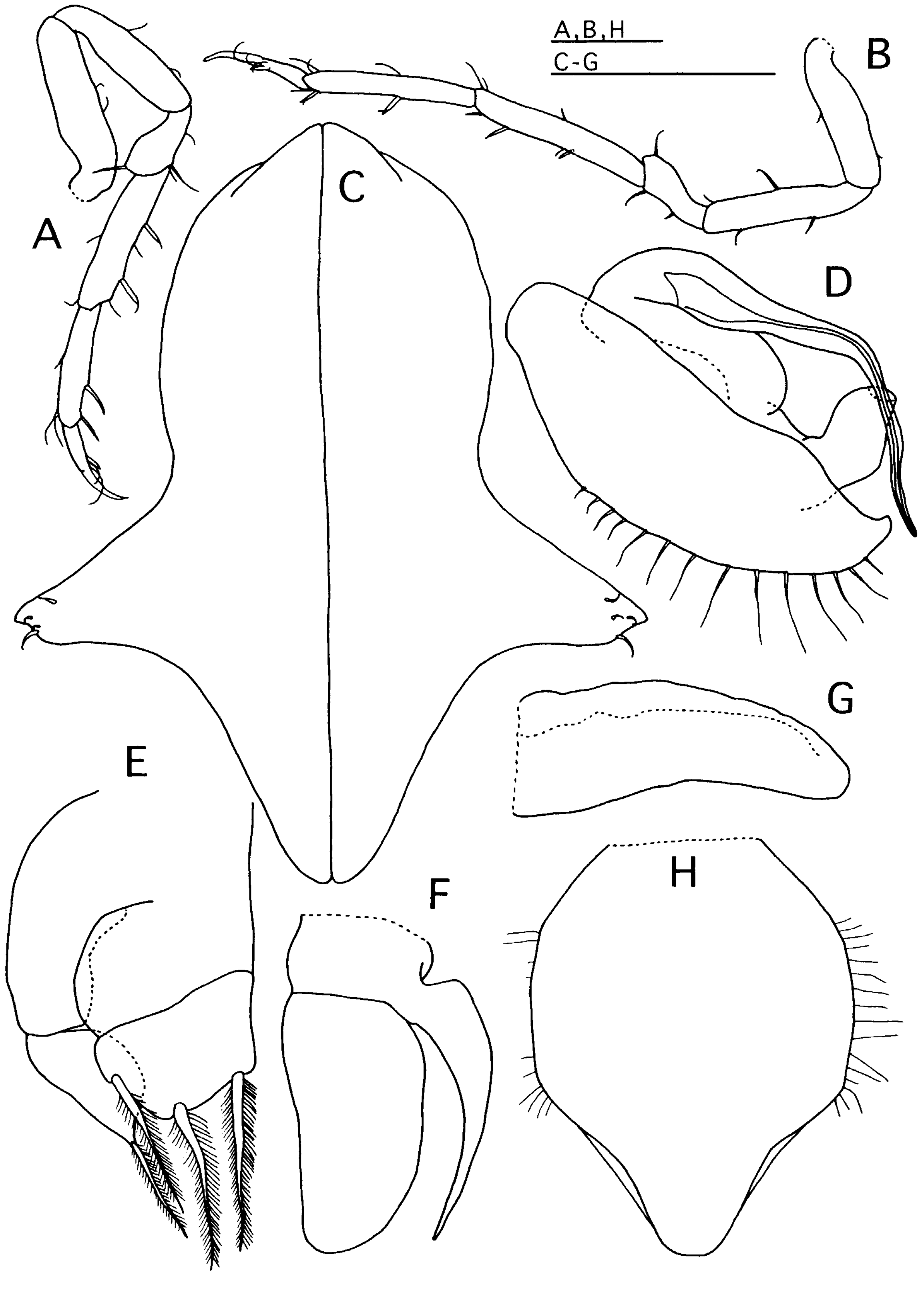

Fig. 6. *Munnogonium orientale* sp. nov. A–G, holotype male; H, paratype female (ZIHU-01322): A, right pereopod 2, mesial; B, right pereopod 7, mesial; C, pleopod 1, ventral; D, right pleopod 2, ventral; E, right pleopod 3, ventral; F, left pleopod 4, ventral; G, right pleopod 5, dorsal; H, operculum, ventral. Scales=0.1 mm.

tenna 2: the article 3 is distinctly thicker in the male than in the female (Schiecke and Fresi 1972). The present new species is the second species exhibiting similar sexual dimorphism. It is distinguished from *M. maltinii* by the following features (those of *M. maltinii* are given in parentheses): head with an anterodorsal short projection bearing a shallow notch (without projection); coxal plates of pereonites 1-4 dorsally visible and with 1 spine in male (coxal plates of pereonites 1-4 dorsally not visible), and male pleopod 1 with long, broad, lateral projections each bearing 1 long, posterolateral seta and 3 short, ventral setae (short, slender, lateral projections each with 1 anterolateral and 4 apical setae).

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